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Dieting and Disordered Eating Behaviors from Adolescence to Young Adulthood: Findings from a 10-Year Longitudinal Study

DIANNE NEUMARK-SZTAINER, PhD, MPH, RD; MELANIE WALL, PhD; NICOLE I. LARSON, PhD, MPH, RD; MARLA E. EISENBERG, ScD, MPH; KATIE LOTH, MPH, RD

ABSTRACT

Background Disordered eating behaviors are prevalent in adolescence and can have harmful consequences. An important question is whether use of these behaviors in adolescence sets the pattern for continued use into young adulthood.

Objective To examine the prevalence and tracking of dieting, unhealthy and extreme weight control behaviors, and binge eating from adolescence to young adulthood.

Design Population-based, 10-year longitudinal study (Project EAT-III: Eating Among Teens and Young Adults, 1999-2010).

Participants/setting The study population included 2,287 young adults (55% girls, 52% nonwhite). The sample included a younger group (mean age 12.8 ± 0.7 years at baseline and 23.2 ± 1.0 years at follow-up) and an older

group (mean age 15.9 ± 0.8 at baseline and 26.2 ± 0.9 years at follow-up).

Statistical analyses performed Longitudinal trends in prevalence of behaviors were tested using generalized estimating equations. Tracking of behaviors were estimated using the relative risk of behaviors at follow-up given presence at baseline.

Results In general, the prevalence of dieting and disordered eating was high and remained constant, or increased, from adolescence to young adulthood. Furthermore, behaviors tended to track within individuals and, in general, participants who engaged in dieting and disordered eating behaviors during adolescence were at increased risk for these behaviors 10 years later. Tracking was particularly consistent for the older girls and boys transitioning from middle adolescence to middle young adulthood.

Conclusions Study findings indicate that disordered eating behaviors are not just an adolescent problem, but continue to be prevalent among young adults. The tracking of dieting and disordered eating within individuals suggests that early use is likely to set the stage for ongoing use. Findings suggest a need for both early prevention efforts before the onset of harmful behavioral patterns as well as ongoing prevention and treatment interventions to address the high prevalence of disordered eating throughout adolescence and young adulthood.

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D. Neumark-Sztainer, is a professor, N. I. Larson is a research associate, and K. Loth is a research assistant, Division of Epidemiology and Community Health, School of Public Health, University of Minnesota, and M. E. Eisenberg is an assistant professor of pediatrics and adolescent health, Department of Pediatrics, University of Minnesota, Minneapolis. M. Wall is a professor of biostatistics in psychiatry, Departments of Biostatistics and Psychiatry, Columbia University, New York, NY; at the time of the study, she was a professor, Division of Biostatistics, School of Public Health, University of Minnesota, Minneapolis.

Address correspondence to: Dianne Neumark-Sztainer, PhD, MPH, RD, Division of Epidemiology and Community Health, School of Public Health, University of Minnesota, 1300 S Second St, Suite 300, Minneapolis, MN 55454. E-mail: neumark@epi.umn.edu

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Dieting, unhealthy weight control practices, and binge eating are often associated with poorer dietary intake (1-3). For example, in a population-based sample of Canadian adolescents, Woodruff and col-



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leagues (2) found that overall dietary quality was lower among youth who were dieting and had weight concerns, compared to those not dieting and not weight concerned. Furthermore, dieting and disordered eating behaviors have been found to predict a number of problematic outcomes, including increased risk for weight gain (4-8), obesity (6-8), and eating disorders (9-12) in adolescents (4,6,7,12) and young adults (5,12,13). For example, in an analysis from an earlier study wave on the population participating in our study (8), we found that adolescents engaging in dieting and those reporting unhealthy weight control behaviors were at two to three times greater risk for being overweight 5 years later, compared to adolescents who did not engage in these behaviors at baseline. Given the harmful consequences associated with disordered eating behaviors, it is important to develop interventions aimed at their prevention.

A frequently asked question regards the best timing for interventions aimed at preventing disordered eating. A high prevalence of disordered eating behaviors during adolescence would support early prevention efforts, with the goal of intervening before the onset of these behaviors. If the prevalence of disordered eating remains stable or increases as young people transition throughout adolescence, then prevention efforts should be continued throughout these life transitions. Although cross-sectional studies have shown a high prevalence of disordered eating during early and middle adolescence (14-16), longitudinal studies examining the course of disordered eating from early adolescence to young adulthood are limited in number and scope, and findings have not been consistent, possibly due to small samples and differences in participant characteristics and study methodologies (13,17-22). Information regarding whether or not disordered eating tracks within individuals is also important in setting program priorities. Most research suggests that disordered eating behaviors during early adolescence are predictive of continued use of these behaviors, as well as progression to a clinical eating disorder during later adolescence or young adulthood (18,19,21-25). However, previous studies have limited generalizability given that most have been conducted within predominantly white samples (13,17,18,20,21) of women (19-23), primarily of high socioeconomic status (21,22).

Our study expands upon the existing literature by examining the prevalence and tracking of dieting and disordered eating behaviors, including unhealthy weight control behaviors, extreme weight control behaviors, and binge eating with loss of control, longitudinally during a 10-year transitional period from adolescence to young adulthood, in a large and diverse population-based sample of young women and men. The first aim of the study was to assess the prevalence of dieting and disordered eating as adolescents move into young adulthood. The second study aim was to determine whether these behaviors track within individuals over time. Specifically, we examined whether adolescents who diet and engage in disordered eating behaviors are at increased risk for these behaviors in young adulthood.

METHODS

Study Design and Population

Project EAT-III (Eating and Activity in Teens and Young Adults) is a 10-year longitudinal study aimed at examining eating, activity, and weight-related variables among young people. The sample for our study included 1,030 young men and 1,257 young women. One third of participants (29.9%) were in the younger cohort; at baseline they were in early adolescence (mean age 12.8 ± 0.7 years), and at 10-year follow-up they were in early young adulthood (mean age 23.2 ± 1.0 years). Two thirds of participants (70.1%) were in the older cohort; at baseline they were in middle adolescence (mean age 15.9 ± 0.8 years), and at follow-up they were in middle young adulthood (mean age 26.2 ± 0.9 years).

At baseline (EAT-I: 1998-1999), 4,746 junior and senior high school students at 31 public schools in the Minneapolis/St Paul, MN, metropolitan area completed in-class surveys and anthropometric measures (15,26). At 10-year follow-up (EAT-III: 2008-2009) participants were mailed letters inviting them to complete online or paper surveys. Data were also collected at 5-year follow-up and longitudinal trends in weight control behaviors have previously been described (27). The 5-year follow-up data are not included in this analysis to focus on long-term changes in the prevalence and tracking of behavior patterns and determine whether behaviors begun in adolescence predict similar behaviors in young adulthood. All study protocols were approved by the University of Minnesota's Institutional Review Board Human Subjects Committee. Parental consent and written assent from participants was obtained at baseline. For follow-up surveys, participants reviewed a consent form as part of the online survey or were mailed a consent form with their paper survey. Completion of the Project EAT-III survey implied written consent.

At 10-year follow-up, survey data were collected from 66.4% of those for whom correct contact information was available, representing 48.2% of the original cohort, for a final sample of 2,287 young adults. Attrition was not equal across sociodemographic characteristics. When compared to nonrespondents in Project EAT-III, respondents were more likely to be girls, white, and of higher socioeconomic status (SES). Thus, in all analyses, we weighted our data to allow for the longitudinal sample to be more similar to the original cohort, and more representative of an adolescent/young adult population. Data were weighted using the response propensity method (28) where the inverse of the estimated probability that an individual responded at follow-up was used as the weight. We compared responders at follow-up with nonresponders for the variables being examined in this analysis (ie, dieting, unhealthy and extreme weight control behaviors, and binge eating with loss of control). These comparison analyses were stratified by sex and adjusted for SES, ethnicity/race, and nonresponse weights. In all but one case (responding boys reported lower extreme weight control behaviors than nonresponders) there were no significant differences found for the targeted variables at baseline, indicating that the weighting was generally successful in correcting for any response bias. The final weighted sample was 48.4% white, 18.6% African American, 19.6% Asian, 5.9% Hispanic, 3.3% Native American,

and 4.2% mixed or other race/ethnicity and was well distributed across five levels of SES: low (18.0%), middle-low (19.0%), middle (26.2%), middle-high (23.3%) and high (13.5%).

Measures

Dieting was assessed with the question, "How often have you gone on a diet during the last year? By 'diet' we mean changing the way you eat so you can lose weight." Responses included "never," "one to four times," "five to 10 times," "more than 10 times," and "I am always dieting." As in previous analyses (8), responses were dichotomized into nondieters (responded never) and dieters (other responses) (test-retest agreement [nondieter vs dieter] 92%).

Unhealthy and extreme weight control behaviors were assessed with the question, "Have you done any of the following things in order to lose weight or keep from gaining weight during the past year?" (yes/no for each method). Responses categorized as unhealthy weight control behaviors included "fasted," "ate very little food," "used a food substitute (powder or a special drink)," "skipped meals," and "smoked more cigarettes." Consistent with prior analyses (27), those reporting the use of one or more unhealthy weight control behaviors were coded as using unhealthy weight control behaviors (test-retest agreement [none vs one or more behaviors] 83%). Extreme weight control behaviors included took diet pills, made myself vomit, used laxatives, and used diuretics. Those reporting the use of one or more of these behaviors were coded as using extreme weight control behaviors (test-retest agreement [none vs one or more behaviors] 97%). Unhealthy and extreme weight control behaviors were also examined individually.

Binge eating with loss of control was assessed with the questions: "In the past year, have you ever eaten so much food in a short period of time that you would be embarrassed if others saw you (binge eating)" (yes/no). "During the times when you ate this way, did you feel you couldn't stop eating or control what or how much you were eating" (yes/no) (29). Those reporting yes to both of these questions were coded as engaging in binge eating with loss of control (test-retest agreement 92% [first question] and 84% [second question]).

Sex, age, race/ethnicity, and SES were based on self-report. Participants were asked about their race/ethnicity (test-retest $\kappa=0.70-0.83$) as prior research has identified racial/ethnic differences in weight-related variables among young people (5,30). The prime determinant of SES was the higher education level of either parent (test-retest $\kappa=0.78$) during the administration of the Project EAT-I survey (31).

Statistical Analysis

Longitudinal trends in the prevalence of different behaviors were estimated and tested using generalized estimating equations (32) to account for correlation within individuals across time. Specifically, for each outcome, log binomial models (33) were used including a main effect for year (1999 or 2010), cohort (younger or

older), and a year by cohort interaction along with control variables including baseline ethnicity/race and SES and nonresponse weights. The time trends in each cohort were tested based on these models by forming contrasts combining the generalized estimating equation estimates of the main effect for year and the year by cohort interaction. Regression-adjusted prevalences of behaviors over time and by cohort were obtained based on the fitted log binomial models using the predicted probability for a person with average values on the control variables.

Tracking of behaviors within-person over time was estimated and tested using log binomial models of follow-up behaviors on baseline behaviors stratified by cohort and sex and controlling for nonresponse weights. Relative risks from these fitted models were used to test tracking and represent how many times more likely an individual was to be doing a behavior at follow-up given that they were doing the behavior at baseline. *P* values and 95% confidence intervals for relative risks were calculated based on the likelihood ratio test. SAS version 9.2 (2010, SAS Institute Inc, Cary, NC) was used for all analyses.

RESULTS

Prevalence of Dieting and Disordered Eating: Adolescence to Young Adulthood

About half of girls reported dieting in the past year as compared to about a fourth of the boys. Among both age cohorts of girls, the prevalence of dieting remained fairly constant from adolescence through young adulthood (Figure 1). Among boys, the prevalence of dieting stayed constant over time in the younger age cohort, but significantly increased in the older cohort as participants progressed from middle adolescence to middle young adulthood (21.9% to 27.9%, $P<0.001$).

In younger girls, the prevalence of unhealthy weight control behaviors remained constant from early adolescence to early young adulthood (Figure 1). Among older girls, the prevalence of unhealthy weight control behaviors showed a statistically significant decrease from middle adolescence to middle young adulthood, but still remained very high (60.7% to 54.4%, $P=0.004$). Approximately one third of boys reported unhealthy weight control behaviors, and the prevalence remained fairly constant during the study period in both age cohorts.

For extreme weight control behaviors, significant increases from adolescence to young adulthood were found in girls for both age cohorts and for the older cohort of boys (Figure 1). Among girls, the use of extreme weight control behaviors increased from 8.4% to 20.4% ($P\leq 0.001$) between early adolescence and early young adulthood and from 12.6% to 20.6% ($P<0.001$) between middle adolescence and middle young adulthood. For the older boys, extreme weight control behaviors increased from 2.1% in middle adolescence to 7.3% in middle young adulthood ($P<0.001$).

Binge eating increased in the older cohorts of both girls and boys (Figure 1). Among girls, the prevalence increased from 9.9% during middle adolescence to 14.1% in middle young adulthood ($P=0.012$). Among

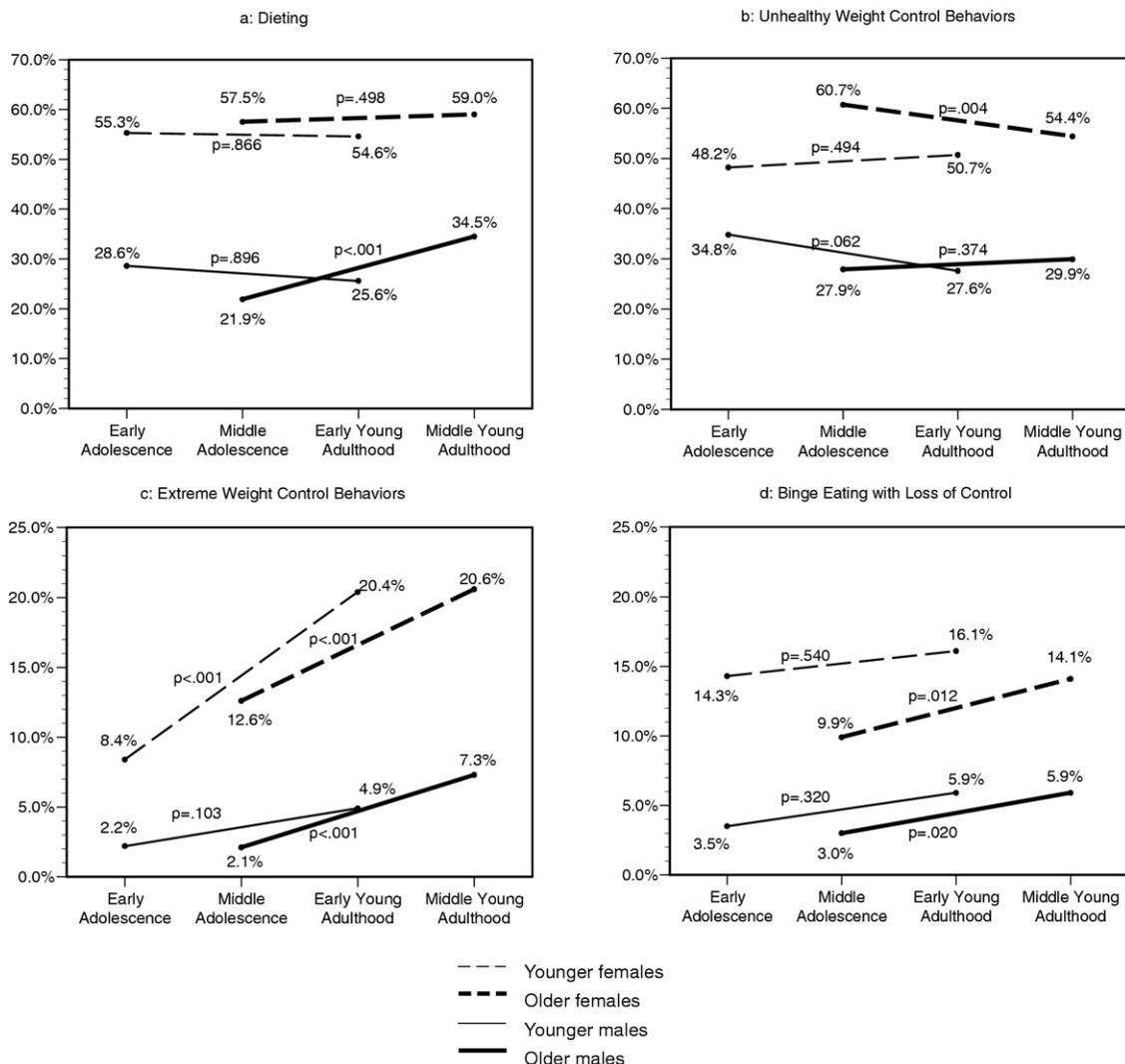


Figure 1. Prevalences of dieting, unhealthy and extreme weight control behaviors, and binge eating with loss of control from adolescence to young adulthood, by age cohort and sex, adjusted for socioeconomic status and ethnicity/race. *P* values test change over time. NOTE: Information from this figure is available online at www.adajournal.org as part of a PowerPoint presentation.

boys, the prevalence of binge eating increased from 3.0% in middle adolescence to 5.9% in middle young adulthood ($P=0.020$). Increases in binge eating among the younger cohorts of boys and girls were not statistically significant.

An examination of the specific types of extreme weight control behaviors revealed significant increases in diet pill use for all age and sex groups over the 10-year study period (see Figure 2). Among girls, diet pill use increased from 3.3% to 12.4% ($P<0.001$) between early adolescence and early young adulthood and from 6.5% to 16.1% ($P<0.001$) between middle adolescence and middle young adulthood. For boys, diet pill use increased from 0.6% to 3.8% ($P=0.017$) between early adolescence and early young adulthood and from 1.1% to 6.6% ($P<0.001$) between middle adolescence and middle young adulthood. Laxative use increased from 1.3% among girls in middle adolescence to 4.8% among girls in middle young adult-

hood ($P<0.001$). In contrast, vomiting decreased from 6.8% during middle adolescence to 4.0% in middle young adulthood ($P=0.010$) among the older cohort of girls. Changes in diuretics were not statistically significant.

Tracking of Dieting and Disordered Eating from Adolescence to Young Adulthood

Dieting and disordered eating tended to track from adolescence to young adulthood, particularly among the older cohorts of girls and boys transitioning from middle adolescence to middle young adulthood (see the Table). Girls and boys from both age cohorts who dieted in adolescence were significantly more likely to diet in young adulthood, compared to those who didn't diet during adolescence. Similarly, adolescents from all four age and sex groups who used unhealthy weight control behaviors in adolescence were at significantly greater risk for these behav-

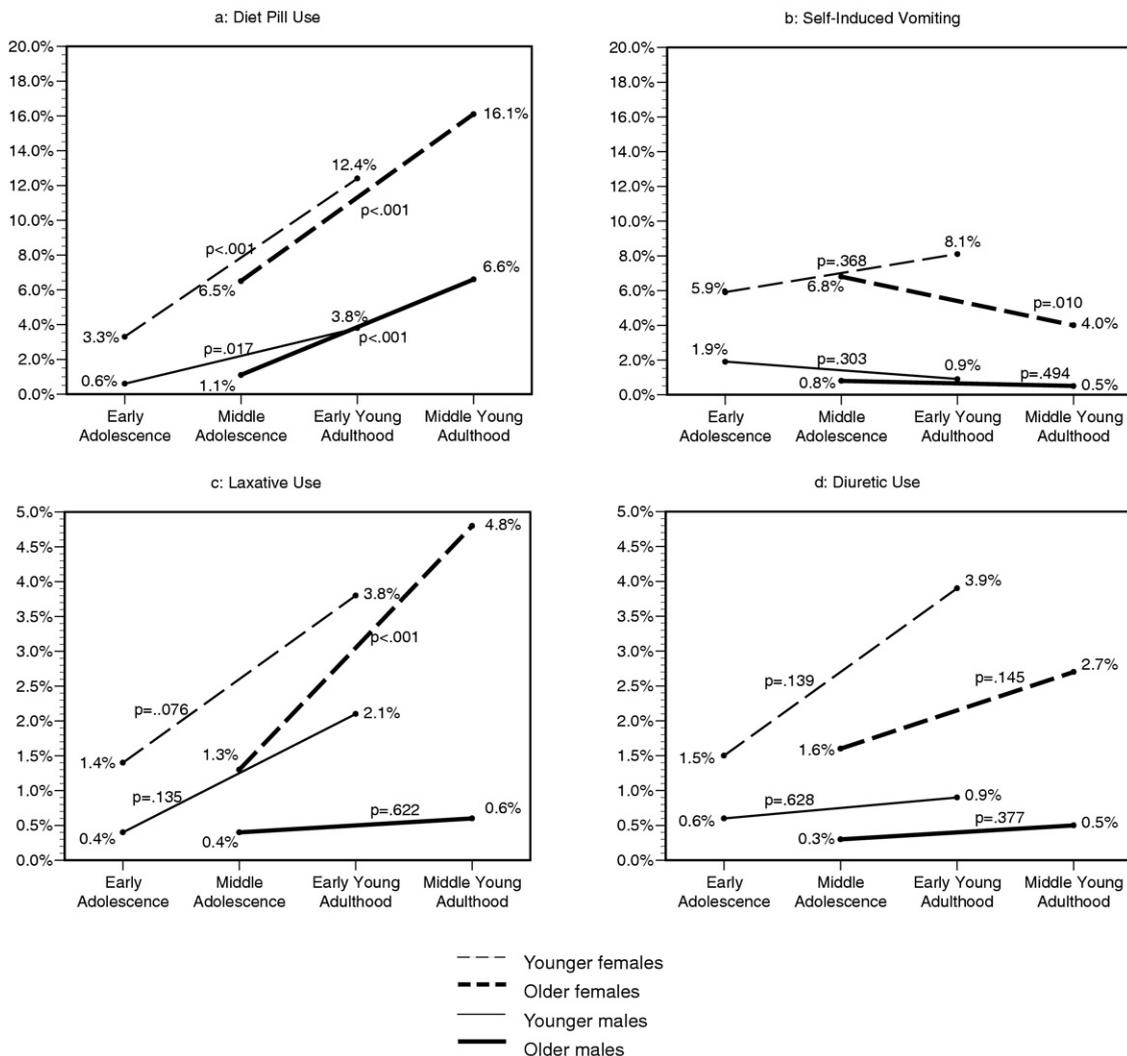


Figure 2. Prevalences of specific extreme weight control behaviors from adolescence to young adulthood, by age cohort and sex, adjusted for socioeconomic status and ethnicity/race. *P* values test change over time. NOTE: Information from this figure is available online at www.adajournal.org as part of a PowerPoint presentation.

iors in young adulthood. Use of extreme weight control behaviors during middle adolescence predicted greater risk for these behaviors 10 years later during middle young adulthood for the older cohorts of girls and boys. Finally, binge eating during adolescence increased risk for binge eating during young adulthood for the older cohorts of girls and boys and for the younger girls.

DISCUSSION

This study found that, in general, the prevalence of dieting and disordered eating behaviors was high and either remained constant or increased from adolescence to young adulthood. Of particular concern was the large increase in extreme weight control behaviors among youth transitioning from adolescence to young adulthood. Diet pill use more than tripled in most of the age and sex groups during the 10-year study period. Of concern, one fifth of female young adults reported the use of extreme

weight control behaviors. Furthermore, behaviors tended to track within individuals and, in general, participants who engaged in dieting and disordered eating behaviors during adolescence were at increased risk for these behaviors 10 years later. Tracking was particularly consistent for the older girls and boys transitioning from middle adolescence to middle young adulthood. The tracking of these potentially harmful behaviors suggests that their use is not just a phase that adolescents go through, but instead indicate that early use of dieting and disordered eating behaviors may set the stage for continued use of these behaviors later on. Together the findings suggest a need for both early prevention efforts before the onset of behavioral patterns that tend to continue over time, as well as ongoing prevention and treatment interventions to address the high prevalence throughout adolescence and young adulthood.

Findings from this study are generally in agreement

Table. Tracking of dieting, unhealthy and extreme weight control behaviors, and binge eating during a 10-year period from adolescence to young adulthood by age and sex^a

Behavior	Younger Females (n=308)			Older Females (n=722)			Younger Males (n=377)			Older Males (n=880)		
	RR	95% CI	P value	RR	95% CI	P value	RR	95% CI	P value	RR	95% CI	P value
Dieting	1.32	(1.09, 1.60)	0.005	1.61	(1.41, 1.83)	<0.001	1.46	(1.03, 2.05)	0.033	2.27	(1.89, 2.72)	<0.001
Unhealthy weight control behaviors	1.54	(1.27, 1.87)	<0.001	1.73	(1.49, 2.01)	<0.001	1.63	(1.19, 2.24)	0.002	2.10	(1.72, 2.56)	<0.001
Extreme weight control behaviors	1.22	(0.68, 2.20)	0.509	2.13	(1.62, 2.80)	<0.001	1.07	(0.11, 10.02)	0.955	6.43	(3.63, 11.37)	<0.001
Binge eating with loss of control	2.21	(1.31, 3.71)	0.003	2.42	(1.68, 3.47)	<0.001	0.47	(0.03, 7.12)	0.586	5.27	(2.68, 10.34)	<0.001

^aRelative risks (RRs) and 95% confidence intervals (CIs) for engaging in behaviors in young adulthood if engaged in behavior during adolescence as compared to not having engaged in behavior in adolescence.
NOTE: Information from this table is available online at www.adajournal.org as part of a PowerPoint presentation.

with the available research that has examined population-based samples of boys and girls from adolescence through young adulthood, although there are some notable differences. Results from this study showing sex differences in the course of disordered eating behaviors are in agreement with a prior 10-year longitudinal study conducted by Heatherton and colleagues among young people who were college students in 1982 (13). Both studies showed dieting and disordered eating behaviors continue to be more prevalent among girls than boys as they transition through adolescence and young adulthood. In addition, both studies found evidence of increases in dieting among boys as they age through their 20s. However, Heatherton and colleagues (13) found that dieting and disordered eating behaviors decreased among females transitioning to middle young adulthood, whereas in our study, the prevalence of these behaviors either increased or remained constant over time. These differences might reflect the use of different measures, secular trends, or real differences between the two sample populations. Heatherton and colleagues (13) conducted their baseline analysis on college students in 1982, nearly 30 years ago, thus secular changes are certainly possible. Furthermore, the sample studied by Heatherton and colleagues (13) was drawn from a selective northeastern college in the United States, and had much higher levels of dieting at baseline (75%) than the Project EAT population (50%). With regard to the tracking of behaviors, Kotler and colleagues (18) examined longitudinal relationships between childhood, adolescent, and adulthood eating disorders over a 17-year interval. Their study population differed from the Project EAT population in that participants were drawn from a rural area and were primarily white. In addition, outcome measures differed across the studies. Nevertheless, findings from both studies are similar in showing that disordered eating behaviors tend to track between adolescence and adulthood.

Study strengths include the population-based nature of the sample; its large size; and its diversity in terms of sex, ethnicity/race, and SES. Much of the previous longitudinal work examining the course of disordered eating or eating disorders have included samples that were either female (19-23), primarily white (13,17,18,20,21), or from higher SES backgrounds (21,22), limiting the generalizability of the findings. The long follow-up period, which captured major periods of transition, is another study strength as few other studies have followed adolescents into middle young adulthood. Finally, the use of two age cohorts allowed for the capturing of slightly different stages of transition and for the replication of findings in different individuals. However, study limitations also need to be taken into account in interpreting the findings. Dieting and disordered eating behaviors were assessed with brief self-reported measures and frequency of use of behaviors was not assessed. The use of diet pills once during the past year, while of concern, is less of a concern than the weekly use of diet pills. In addition, there was attrition from the original study population. For this reason, analyses only included individuals who were present at both EAT-I and EAT-III assessments, and the population was weighted by nonresponse propensity so that the statistical results can be considered more representative of the original school-based sample.

CONCLUSIONS

The ineffectiveness of dieting for weight gain prevention during adolescence (4-8), the harmful consequences associated with disordered eating behaviors (19,34-37), and the high prevalence of these behaviors during adolescence (21,38-40) have been shown in previous studies. This study adds to this concerning body of literature by demonstrating that the high prevalence of these behaviors continues from adolescence through young adulthood. Furthermore, individuals who begin these behaviors during adolescence are placing themselves at increased risk for their continued use 10 years later. Further research should explore tracking of dieting and disordered eating from adolescence to later stages of adulthood. Research with population-based samples is also needed to identify factors that predict continued use of these behaviors and progression to more serious outcomes such as eating disorders. It is also important to examine the effects of persistent use of dieting and disordered eating behaviors on behavioral, physical, and psychological outcomes such as binge eating, weight status, and depression. Finally, it is crucial to implement and evaluate interventions. Findings from this study, in conjunction with previous studies, argue for early and ongoing efforts aimed at the prevention, early identification, and treatment of disordered eating behaviors in young people. Within clinical practices, dietetics practitioners and other health care providers should be asking about the use of these behaviors before adolescence, throughout adolescence, and into young adulthood. Given the growing concern about obesity, it is important to let young people know that dieting and disordered eating behaviors can be counterproductive to weight management (4-8). Young people concerned about their weight should be provided with support for healthful eating and physical activity behaviors that can be implemented on a long-term basis, and should be steered away from the use of unhealthy weight control practices.

STATEMENT OF POTENTIAL CONFLICT OF INTEREST:

No potential conflict of interest was reported by the authors.

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